Digital Elevation Models of Southeast Atlantic Coast: Procedures, Data Sources, and Analysis

Prepared for the Consumer Option for an Alternative System to Allocate Losses (COASTAL) Act by the NOAA National Centers for Environmental Information (NCEI)
January 24, 2019
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Summary

In January of 2019, NOAA's National Centers for Environmental Information (NCEI) developed integrated bathymetric–topographic digital elevation models (DEMs) according to specifications developed jointly by NOAA NCEI and the United States Geological Survey (USGS) to help better define a consistent elevation mapping framework for the nation (Table 1). Overall, 102 tiled DEMs were created in the area of interest: 75 tiles were created at the highest resolution of 1/9 arc-second, 27 were created at a resolution of 1/3 arc-second. Only 1/9 arc-second DEM tiles integrate topography and bathymetry. The DEM tiles represent best publicly-available data at the time of their creation; the intent is to update specific tiles as new source data becomes available. The utilization of a tiling scheme in developing the DEMs is intended to improve data management during source data processing as well as facilitate targeted DEM updates.

The tiled DEMs cover the Southeast Atlantic Coast including portions of the Georgia coast north of Brunswick, Georgia, the entire South Carolina coast, and portions of the North Carolina coast south of Cape Lookout, North Carolina. The extents of these DEMs, procedures, data sources, and analysis are described below. The methodologies used by NCEI in developing DEMs are described in the NOAA National Centers for Environmental Information Topo-Bathymetric Digital Elevation Models: East Florida (Amante, 2018).

DEM Specifications

The Southeast Atlantic Coast tiled DEMs were built to the specifications listed in Table 1. Figure 1 shows the 1/9 arc-second DEM tile boundaries in yellow and the 1/3 arc-second DEM tile boundaries in green.

Table 1. Specifications for the DEM tiles.

Grid Area	*Southeast Atlantic Coast*
Coverage Area	82.00° to 76.25° W, 31.00° to 34.75° N
Coordinate System	Geographic decimal degrees
Horizontal Datum	NAD 83
Vertical Datum	NAVD 88
Vertical Units	Meters
Cell Size	Variable
Grid Format	Geotiff

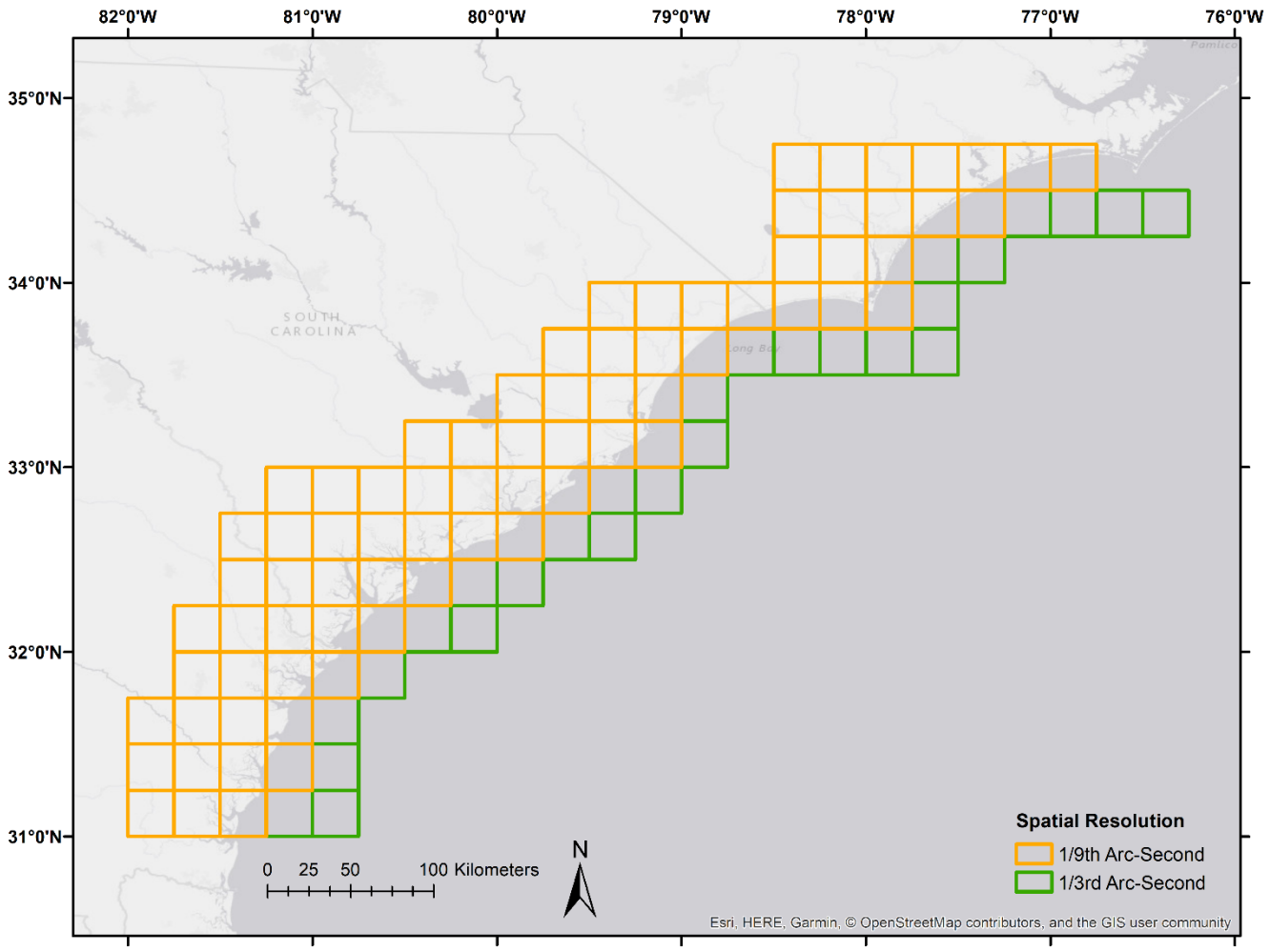

Figure 1. Map image of the DEM tile boundaries for the Southeast Atlantic Coast DEMs.

Data Sources and Processing

Bathymetry data used in the generation of the Southeast Atlantic Coast DEMs included NOAA National Ocean Service (NOS) hydrographic surveys and bathymetric attributed grids (BAGs), NOAA Office of Coast Survey

(OCS) Electronic Navigational Chart (ENC) soundings, NCEI multibeam survey data, U.S. Army Corps of Engineers (USACE) channel condition surveys, and the International Hydrographic Organization (IHO) crowd-sourced bathymetry (Table 2).

Table 2: Bathymetric data sources used in DEM development.

Source	*Date*	*Data Type*	*Spatial Resolution*	*Horizontal Datum*	*Vertical Datum*
NOAA NOS	1876 to 2017	Hydrographic survey soundings	< 10 meters to several kilometers	NAD 83 geographic	Mean Lower Low Water (MLLW)
NOAA OCS	1934 to 2017	Extracted chart soundings	~50 meters to several kilometers	NAD 83 geographic	MLLW
NCEI	2001 to 2018	Multibeam Bathymetric Surveys	~1 to 10 meters	NAD 83 geographic	Assumed Instantaneous Water Level
NOAA NOS BAG	2006 to 2016	Hydrographic survey soundings	0.5 to 30 meters	NAD 83 geographic	MLLW
USACE	2011 to 2018	Hydrographic channel condition surveys	~1 to 10 meters	Georgia, South Carolina, or North Carolina State Plane	MLLW
IHO Crowd-sourced Bathymetry	2013 to 2018	Crowdsourced Hydrographic survey soundings	~1 to 10 meters	NAD 83 geographic	Assumed Instantaneous Water Level
NCEI	2018	Digitized Lake Depths (Lake Moultrie, SC)	1/9 arc-second	NAD 83 geographic	North American Vertical Datum of 1988 (NAVD88)

Bathymetric data were transformed to NAD 83 and NAVD88 as needed and where more recent, higher resolution data existed, older data were edited or superseded. Vertical datum transformations were performed using NOAA's VDatum Software.

Bathymetric-topographic data used in developing the Southeast Atlantic Coast DEMs included bathymetric-topographic lidar from NOAA National Geodetic Survey (NGS) and USACE (Table 3).

Table 3: Bathymetric-Topographic data sources used in DEM development.

Source	*Date*	*Data Type*	*Spatial Resolution*	*Horizontal Datum*	*Vertical Datum*
NOAA NGS Topobathy Lidar: Post Sandy (SC to NY)	2014	Bathymetric-Topographic Lidar	Variable	NAD 83 geographic	NAVD88
USACE Post-Matthew Topobathy	2016	Bathymetric-Topographic Lidar	Variable	NAD 83 geographic	NAVD88

Lidar: Southeast Coast (VA, NC, SC, GA, FL)					
NOAA NGS Topobathy Lidar DEM: Coastal South Carolina	2016 -2017	DEM derived from Bathymetric-Topographic Lidar	3 meters	NAD 83 geographic	NAVD88

Topographic data used in developing the Southeast Atlantic Coast DEMs included gridded topographic data from NCEI, and high-resolution lidar data from the South Carolina Department of National Resources (DNR), USGS, North Carolina Floodplain Mapping Program (NCFMP), and lidar collections from individual counties in Georgia and South Carolina (Table 4).

Table 4: Topographic data sources used in DEM development.

Source	***Date***	***Data Type***	***Spatial Resolution***	***Horizontal Datum***	***Vertical Datum***
NCEI CRM Volume 2	1998	DEM	3 arc-seconds	NAD 83 geographic	Sea Level (not defined)
NCEI Myrtle Beach, SC DEM	2006	DEM	1/3 arc-second	WGS 84 geographic	NAVD88
NCEI Savannah, GA DEM	2006	DEM	1/3 arc-second	WGS 84 geographic	NAVD88
SC DNR Lidar: Charleston, Colleton & Jasper Counties	2007	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Dorchester County	2007	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Marion County	2008	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Williamsburg County	2008	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
Lidar: Chatham County, GA	2009	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Charleston County	2009	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar:	2009	Topographic Lidar	Variable	NAD 83 geographic	NAVD88

Berkeley County					
SC DNR Lidar: Florence County	2009	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
USGS Lidar: Wayne County (GA)	2010	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
ARRA Lidar: Allendale County (SC)	2010	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
ARRA Lidar: Hampton County (SC)	2010	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
Lidar: Coastal Georgia	2010	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Barnwell County	2012	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
SC DNR Lidar: Beaufort County	2013	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
Lidar: Horry County, SC	2014	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
NCFMP Lidar: Statewide North Carolina (Phase 1)	2014	Topographic Lidar	Variable	NAD 83 geographic	NAVD88
NCFMP Lidar: Statewide North Carolina (Phase 2)	2014	Topographic Lidar	Variable	NAD 83 geographic	NAVD88

DEM Development

Development of the Southeast Atlantic Coast DEMs followed procedures documented in NOAA National Centers for Environmental Information Topo-Bathymetric Digital Elevation Models: East Florida (Amante, 2018). Exceptions being that the bathymetric pre-surface was generated at 1 arc-second due to the coarse resolution of bathymetric data, and gridding weights were modified as shown in Table 5. Also, the bathymetric pre-surface derived from sources in Tables 2 and 3 was converted to XYZ and was the only bathymetric data utilized in the final DEM creation with MB-System's 'mbgrid.'

Table 5: Data hierarchy used to assign gridding weight in MB-System.

Dataset	*Relative Gridding Weight*
NOAA NGS Topobathy Lidar DEM: Coastal South Carolina	100000
USACE Post-Matthew Topobathy Lidar: Southeast Coast	1000
NOAA NGS Topobathy Lidar: Post Sandy (SC to NY)	10
SC DNR Lidar: Charleston, Colleton & Jasper Counties	1
SC DNR Lidar: Dorchester County	1
SC DNR Lidar: Marion County	1
SC DNR Lidar: Williamsburg County	1
Lidar: Chatham County, GA	1
SC DNR Lidar: Charleston County	1
SC DNR Lidar: Berkeley County	1
SC DNR Lidar: Florence County	1
USGS Lidar: Wayne County (GA)	1
ARRA Lidar: Allendale County (SC)	1
ARRA Lidar: Hampton County (SC)	1
Lidar: Coastal Georgia	1
SC DNR Lidar: Barnwell County	1
SC DNR Lidar: Beaufort County	1
Lidar: Horry County, SC	1
NCFMP Lidar: Statewide North Carolina (Phase 1)	1
NCFMP Lidar: Statewide North Carolina (Phase 2)	1
Bathymetric pre-surface	1
NCEI Myrtle Beach, SC DEM	0.01
NCEI Savannah, GA DEM	0.01
NCEI CRM Volume 2	0.001
NCEI Digitized Lakes Depth (Lake Moultrie, SC)	0.000001

DEM Analysis

Once the Southeast Atlantic Coast DEMs were generated, the DEMs were compared to the high-resolution source elevation data and high-resolution imagery. Inconsistencies were evaluated and resolved based on the most reliable data available. The largest outstanding issue with the DEM tiles is the lack of publicly-available lidar datasets for portions of Glynn, Liberty, and Bryant counties in Georgia and Georgetown County, South Carolina. In such areas, older, coarser-resolution, topographic data from previously developed NCEI DEMs (Savannah, Georgia and Charleston, South Carolina) and the NCEI Coastal Relief Model (CRM) Volume 2 were used. Lidar datasets for these counties are expected to become publicly available in the next 1-2 years, and at which time, these DEM tiles will be updated with more accurate, detailed elevation information.

Reference

C.J. Amante (2018) NOAA National Centers for Environmental Information Topo-Bathymetric Digital Elevation Models: East Florida, NOAA, pp. 6.